Product Training Module: Selecting a Thermal Interface Material

Jan 2012

Introduction

- Purpose
  - This training module is used to give an introduction the selection of thermal interface materials
  - Objectives
  - To identify the key properties of thermal interface materials
  - To identify the key design criteria for product selection
  - To identify common applications
  - Content
  - Introduction and background to thermal interface materials
- Learning time
  - 30 mins

Introduction

- Heat management is now a critical design factor for electronic components
- Thermal management solutions must be cost effective, user friendly and developed quickly
- Thermal interfaces materials (TIMS) are usually an afterthought to designs but play a huge factor in the performance and reliability of a device's operation
- Selecting the correct thermal interface material can allow a significant reduction in cost and improvement in device life time.

Types of TIM

- TIMs can be divided into a number of distinct categories
  - Phase Change Materials (PCMS)
  - Silicone based gap fillers
  - Non-silicone based gap fillers
  - Putties
  - Thermal Greases
  - Insulators
  - Adhesive tapes
  - Graphite products

PCMs

- Phase Change Materials (PCMS) are materials which are supplied as a solid pad and then soften and flow when a critical temperature is reached
- When the material flows it fills voids and interstices on the surface and therefore gives a lower thermal resistance between mating surfaces
- T-Global offers PC99 as their PCM material

Silicone Based Gap Fillers

- Silicone based gap fillers are used to fill gaps of 0.1 – 10mm between surfaces and lower thermal resistance by excluding air from the interface
- These materials are generally used under compression of approx. 25 – 40%
- T-Global offers three ranges of silicone gap fillers: L37, H48 and TG which offer solutions for a wide range of engineering applications

Non-Silicone Based Gap Fillers

- Non-Silicone based gap fillers are used to fill gaps of 0.1 – 10mm between surfaces and lower thermal resistance by excluding air from the interface
- These materials are used when the presence of silicone oils could be detrimental to product performance
- These materials are generally used under compression of approx. 25 – 40%
- T-Global offers the PC93 range of non-silicone gap fillers

Putties

- Putties are ultra-soft gap fillers which can be compressed to over 90% of their original thickness to optimise thermal performance
- These products are of particular interest where there are large tolerances to consider
- T-Global offers TGX-2 as an ideal putty material

Thermal Greases

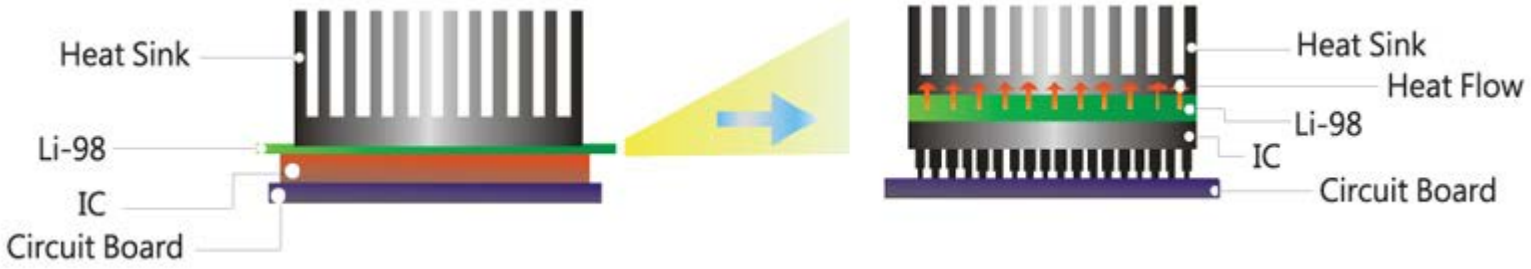
- Thermal greases are materials that act to reduce thermal resistance between mating surfaces by minimising the joint bond line thickness
- They have a relatively high viscosity so that they remain in the gap ever under conditions of vibration
- T-Global offers S606 as an effective thermal grease solution

Insulators

- Insulators are thermal products that electrically insulate between two surfaces while lowering the thermal resistivity
- The key design criteria for the use of insulators is a high dielectric breakdown voltage
- T-Global offers the TI900 range of insulators for optimum performance

Adhesive Tapes

- Adhesive tapes are used when the key design criteria are both thermal management and mechanical attachment
- These products are often used to replace fasteners and reduce the overall cost of ownership of a device
- T-Global offers LI98 as an effective thermal tape

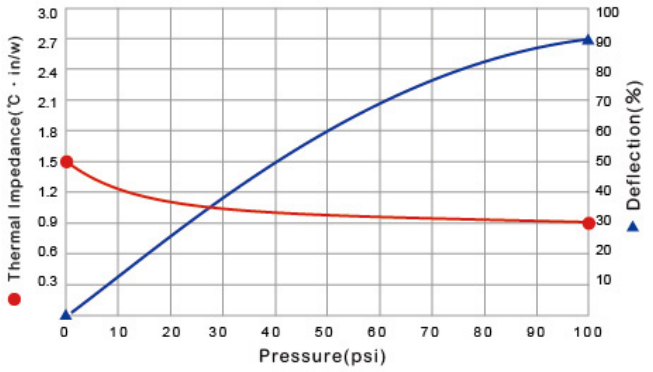


Graphite Products

- Graphite products are used when the key design criteria is both excellent thermal management and electrical conductivity
- T-Global offers the T62 range of graphite pads

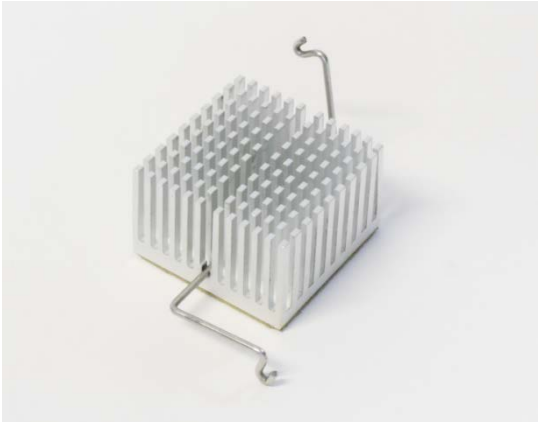
Design Criteria

- Heat Dissipation
  - It is important to determine the amount of heat that needs to be dissipated
  - Low thermal resistance products, such as greases and phase change materials, are much better if a large amount of heat must be removed from a package
  - It is also important to consider clamping pressures as this will greatly effect the TIM's performance



Design Criteria

- Clamping Design
  - It is important to consider how the joint is clamped
  - It is important to consider the minimum and maximum gap and select a thickness of material which maintains the correct amount of compression
  - For high-power dissipation spring clips or fasteners are preferred so that a constant, even pressure is applied

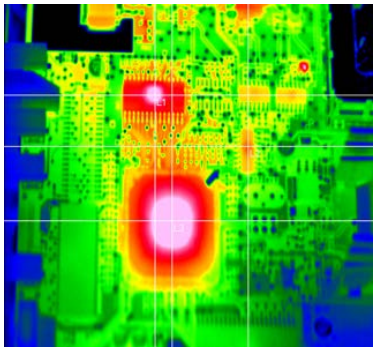


Design Criteria

- Device Footprint
  - With a large device footprint a gap filler or putty is preferred so that all voids and surface irregularities are filled
  - A putty can be used when the surface is particularly rough as it can be highly compressed without generating significant pressure on delicate components
  - For smaller device footprints a grease or PCM material is often more economical

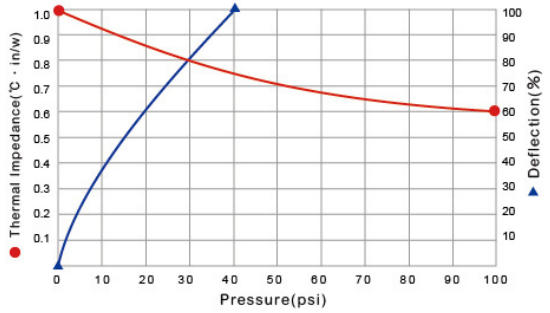
Design Criteria

- Working Temperature
  - It is important that the maximum working temperature of the system is know accurately
  - All TIMs are specified to a maximum working temperature and use for prolonged periods above this temperature can lead to failure
  - Generally non-silicone gap fillers have a slightly lower upper working temperature and this must be taken into consideration during the design process



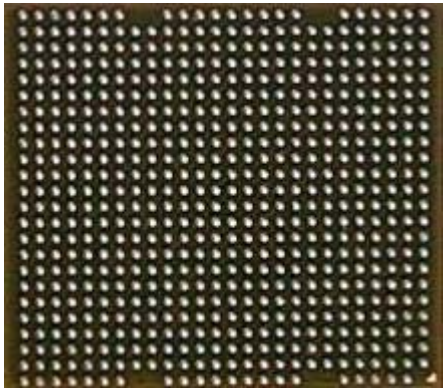
Design Criteria

- Clamping Pressure
  - Clamping pressure will be a key factor for selecting a TIM
  - For low clamping pressures (20 – 50 PSI) a gap filler is recommended, for higher pressures a PCM or grease could be considered
  - Too much pressure applied to silicone based gap fillers can cause them to bleed silicone oils
  - Too low pressure for a grease or PCM will mean that proper thermal management is not achieved and device life time could be significantly shortened



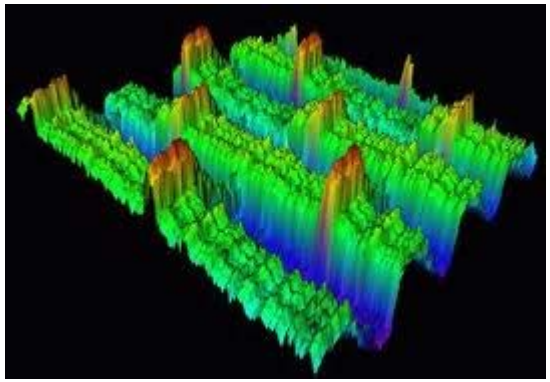
Design Criteria

- Pressure limits
  - If there is a limit of pressure that can be applied, such as when a BGA is used then it is important to use as soft a gap filler as possible
  - For ultra sensitive components a putty is recommended as these can compress by as much as 90% under pressures as low as 2 PSI



Design Criteria

- Surface Finish
  - If the surface is highly machined, such as found in certain military applications almost any TIM can be used
  - If the surface is rough, a gap filler or putty should be used as this will best fill the voids and provide a good path for heat transfer



Design Criteria

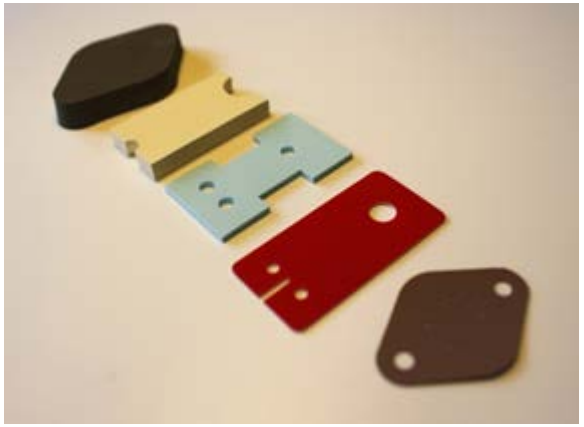
- Electrical isolation
  - The only true conductive TIMs are based on graphite and if electrical conductivity is needed a graphite pad must be used
  - Gap fillers are electrically isolating
  - Phase change and greases are not rated as either conductors or insulators
  - If applied thick enough a PCM or grease can provide some degree of isolation however if voids are present this could give metal to metal contact which could cause a short circuit

Design Criteria

- Reworkability
  - If the joint potentially needs rework it is essential to select a TIM that can be reworked
  - Gap fillers are generally easier to rework than PCM or grease
  - It is generally advised to apply new PCM and grease materials after rework as this will ensure good functionality
  - PCM materials are best removed when slightly warm

Design Criteria

- Packaging Requirements
  - It is important to consider how the materials will be supplied
  - For large volumes materials on rolls or kiss-cut sheets may be the most effective
  - For automated systems a grease may be beneficial as it can be easily dispensed
  - For ease of handling tabbed-liners may also be beneficial to the manufacturing process



Summary

- TIMs are available in a wide range of formats
- Selection of the correct TIM is dependant on a number of design criteria
- It is essential to consider all aspects of the design and how the material is packaged when selecting a TIM to ensure that the solution is both technically suitable and economically viable